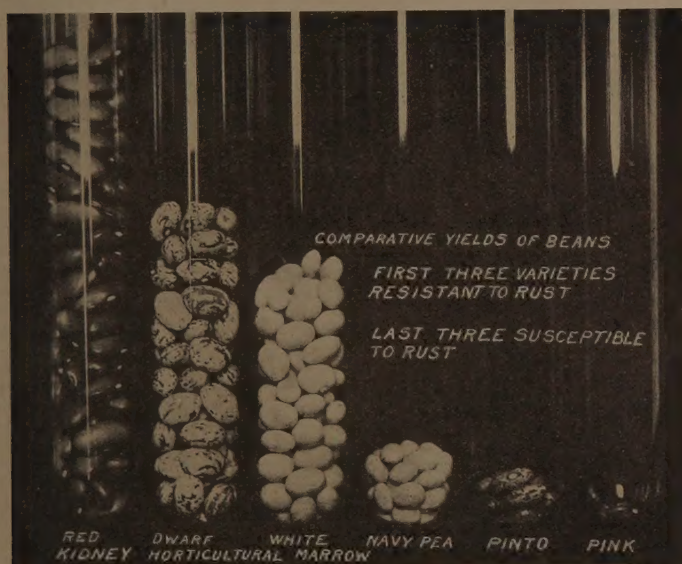


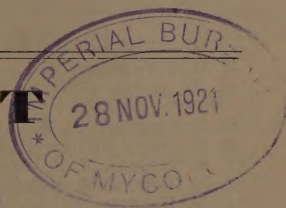
VIRGINIA POLYTECHNIC INSTITUTE
VIRGINIA AGRICULTURAL EXPERIMENT STATION



BEAN RUST

By

F. D. Fromme and S. A. Wingard



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Bean Rust: Its Control through the use of Resistant Varieties¹

By F. D. FROMME and S. A. WINGARD

Bean Rust is a Destructive Disease in Virginia

Bean rust is one of the most destructive of the several common diseases of beans in Virginia. Complaints of the failure of garden and field beans due to attacks of rust have reached us from practically all parts of the State. Losses have sometimes amounted to the complete destruction of the crop.

Although Virginia does not rank as one of the leading bean-growing States, the production of commercial beans, especially of snaps for shipping, local markets and canning, and of dry beans for local markets, represents a considerable industry in the aggregate. The home garden production is undoubtedly much greater than the commercial. One or more kinds of beans are to be found in every home garden and the practice of growing enough dry beans for home use is a common one on many farms. This production has increased considerably during the past two years as a result of the high prices and increased demand incident to the war, and the increased importance of home food production.

This bulletin describes tests of varieties of beans for resistance to the bean rust disease, and names varieties for home or commercial production which may be grown without danger of loss from its attacks.

These studies have been carried on for a period of three years. During this time some 80 varieties, representing most of the varieties listed by seedsmen, have been tested. The tests have been carried on both in the field and in the greenhouse and in addition a number of confirmatory observations have been made on varieties in home gardens and fields. All of the bean varieties included in this report belong to the garden bean, *Phaseolus vulgaris* L., with the exception of Yard Long, which is a species of *Dolichos*. The lima or butter bean is practically immune to rust. A number of varieties of these have been tested in the greenhouse, but only a very slight infection was secured.

¹Paper No. 54 from the laboratory of Plant Pathology.

Appearance of the Disease on Bean Plants

Bean rust is caused by a fungus (*Uromyces appendiculatus*), a member of the well-known group of rust fungi some of which rank as the most destructive of plant parasites; e. g., cedar rust of apples, black stem rust of wheat, and asparagus rust. This disease should not be confused with the anthracnose or pod spot disease, which is unfortunately sometimes called rust. The average seed catalog uses the name rust for anthracnose, and the so-called "rust proof" or "rust resistant" varieties which it lists are in reality supposed to be resistant to anthracnose. This error in naming is all the more inexcusable since the two diseases are easily distinguished.

Bean rust attacks the leaves chiefly and is less commonly found on the pods and stems. All of the injury results from leaf infection and the infections on other parts are of little or no importance. The leaves are covered with the small, reddish-brown spore masses or pustules of the rust (see plate 3 A). These pustules are usually about the size of a pin head and are distributed over the leaves on both upper and lower surfaces. There may be only a few, or so many that every available patch of leaf surface is covered; as many as 2,000 have been counted on a single leaf. They stick up from the surface of the leaf and discharge multitudes of spores which are powdery and rusty-red in color. These come off on the hands or clothing and may even cover the ground under the bean vines with a noticeable rusty coating. These spores, which are called urediniospores, are carried by the wind and other mechanical means to neighboring plants and under suitable conditions set up new infections. The disease spreads quite rapidly and in the course of a few weeks may have become uniformly established over a field of considerable size. On certain varieties there is a noticeable yellow halo surrounding each rust pustule. Within a few days or possibly a week after the rust pustules have appeared the entire leaf begins to yellow and eventually it browns, shrivels, dries up and falls to the ground. This destruction of leaves is, of course, a vital thing from the standpoint of the life of the bean plant. The leaves are the organs which manufacture the food of the plant and their loss results in starvation and death. The rust pustules meanwhile change from a reddish-brown to a blackish-brown color. This change is brought about by the formation of another type of spore, the teliospore, which is a resting spore and serves to carry the fungus over winter.

Anthracnose is chiefly noticeable on the pods, although it is also found on all parts of the plant. It is most easily recognized by the spots on the pods (see plate 5 B). These are sunken, circular in outline, with a dark-red or brown border surrounding a gray center which bears the flesh-colored spore masses of the fungus. There is no rusty powder on the leaf

PLATE 1



A—Variation in susceptibility of pole beans to rust. Left, Horticultural Pole uninjured; right, Cut Short completely defoliated. Photographed August 12.



B—Four varieties of dry-shell beans. Row 1—Tepary; 2—White Marrow; 3—Navy Pea; 4—Lady Washington. Tepary, Navy Pea and Lady Washington are defoliated by the rust attack while White Marrow is only slightly injured. Photographed August 12.

as in the rust disease, but the veins are blackened and killed in small patches. The spots on the pods may be easily confused with those caused by bean blight (see plate 5 A).

Losses from Bean Rust can be Prevented by the use of Resistant Varieties

Recommendations for the control of bean rust in the past have consisted of rotation accompanied by burning of diseased vines and spraying. So far as the writers know there has been no experimental evidence to show that these measures have been effective. Rotation can seldom be rigorously followed in the small home garden, and the feeding and fertilizing value of bean straw makes its destruction by burning inadvisable. The writers have found a much simpler and more effective control in the mere selection of resistant varieties. This not only obviates the expense which accompanies any spray treatment, but makes it possible to disregard rotation as far as bean rust is concerned. This is a point of some importance in connection with pole or climbing beans, since it is a common practice to plant pole beans on the same ground two or more years in succession in the belief that this improves the yield.

TESTS OF FIELD VARIETIES FOR DRY-SHELL PURPOSES

The beans in this test were planted in a half-acre field on the experimental farm at Blacksburg, on May 15, 1918. They were drilled with a hand seeder in rows 28 inches apart. Of the 16 varieties, two, Tennessee Green Pod and Improved Goddard, are not ordinarily grown for dry-shell beans. They were included with the series for purposes of comparison, the former on account of its susceptibility to rust, and the latter on account of its resistance. Each variety occupied a single row 66 feet long in each series, and there were in all nine repetitions of each variety. Owing to a poor stand in some parts of the field the data on the yield were taken from one series only.

In order to secure a uniform infection all the plants in this one series were inoculated with rust spores on June 7, and again on June 17. Although the rust infection which resulted was not heavy, it multiplied rapidly and by July 9 the susceptible varieties were heavily and uniformly rusted, and leaf death and leaf fall were well under way.

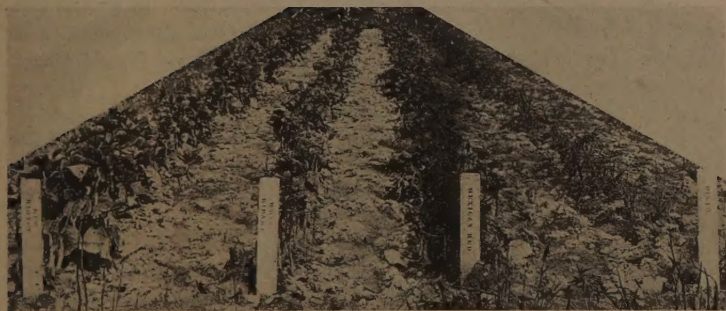
Behavior of the Varieties

The contrast between the more susceptible and more resistant varieties was most strikingly shown in the presence or absence of rust pustules on the

PLATE 2



A—Dry-shell beans. Row 1—Tennessee Green Pod; 2—Blue Pod Navy; 3—French's Horticultural; 4—Yellow Eye. Tennessee Green Pod completely defoliated by rust. The other three varieties show no rust injury. The defoliation of Yellow Eye is due to maturity. A fair set of pods is evident. Photographed August 12.



B—Dry-shell beans. Row 1—Red Kidney; 2—White Kidney; 3—Mexican Red; 4—Pinto. Pinto defoliated by the rust attack. The other three varieties are uninjured. Photographed August 12.

leaves, by the color of the vines and later by the dropping of leaves and the early death of the more susceptible varieties. Some of these features are shown in plates 1, 2, 3 and 4.

The earliest bearers among the susceptible varieties produced some pods before the vines were killed, thus Tennessee Green Pod, Navy Pea, and Snowflake out-yielded Pinto, Pink and Tepary, but all were about equally susceptible. Tepary was so late in bearing that the vines were completely killed before any pods were produced. Lady Washington was not quite so susceptible as any of the foregoing, but was, however, seriously injured and is classed as a susceptible variety.

White Marrow and Blue Pod Navy, though rather heavily rusted, were not seriously injured and continued to bear in spite of the rust.

Mexican Red, Dwarf Horticultural, Improved Goddard, Well's Red Kidney, White Kidney, French's Horticultural and Yellow Eye were either slightly or not at all affected. Some few pustules could usually be found on close inspection, but no injury was apparent.

The varieties in this series are grouped in four classes according to the severity of the rust infection. The terms rust-proof, rust-free, etc., are used arbitrarily and the explanation indicates the state of susceptibility to rust that is to be understood.

1—*Rust-free*.—A very close inspection is necessary to show the presence of any rust pustules. No injury is produced. Improved Goddard, Mexican Red, White Kidney, Well's Red Kidney.

2—*Rust-proof*.—More pustules are produced than in group one, but there is little if any injury. From a practical standpoint these varieties may be classed with group one. Yellow Eye, Dwarf Horticultural, French's Horticultural.

3—*Rust-enduring*.—Moderate rust infection on all or most of the plants followed by a slight leaf fall which does not seriously injure them, or cause cessation of growth and production. White Marrow, Blue Pod Navy.

4—*Rust-susceptible*.—Heavy rust infection resulting in severe leaf fall, cessation of growth and production, and ultimate death of the plants. Tepary, Tennessee Green Pod, Navy Pea, Pink, Pinto, Snowflake, Lady Washington.

PLATE 3



SNOWFLAKE, a rust-susceptible variety. Rust pustules are seen on the upper leaves. The lower leaves, not shown, have fallen.



DWARF HORTICULTURAL, a rust-proof variety. Few or no rust pustules develop. Both photographed July 24.

TABLE I.—*Yield of Varieties of Dry-shell Beans and Their Relative Susceptibility to Rust*

VARIETY	GRAMS DRY BEANS	BUSHEL PER ACRE (calculated)	SUSCEPTIBILITY TO RUST	COLOR OF BEAN
Well's Red Kidney.....	1852	19.2	rust-free	red
Dwarf Horticultural.....	1305	13.5	rust-proof	buff and red
Blue Pod Navy.....	1121	11.6	rust-enduring	dirty white
White Marrow.....	1119	11.5	"	white
Mexican Red.....	1090	11.3	rust-free	red
Yellow Eye.....	938	9.7	rust-proof	white with yellow
French's Horticultural.....	702	7.3	"	tan and red
White Kidney.....	682	7.1	rust-free	white
Lady Washington.....	633	6.6	rust-susceptible	"
Improved Goddard.....	618	6.4	rust-free	buff and red
Snowflake.....	386	3.8	rust-susceptible	white
Navy Pea.....	313	3.2	"	"
Tennessee Green Pod.....	270	2.8	"	brown
Pinto.....	153	1.6	"	buff and brown
Pink.....	14	0.1	"	pink
Tepary.....	complete failure		"	white

The Effect of the Rust Attack on the Yield

These observations on susceptibility to rust were supplemented by the weight of dry beans from the single row of each variety in the series inoculated with rust spores. These yields are given in table I, and for convenience are expressed in terms of bushels per acre. It is recognized that the yield of any variety will vary considerably with seasonal conditions and type of soil, and that several seasons' results are necessary to determine the highest yielding varieties in any locality. Although it is impossible from these single season yields to select the best variety for this locality, or for the State, it is apparent that the seven rust-susceptible varieties may readily be eliminated from further consideration on account of the heavy reductions in yields brought about by the rust attack. It will be noted that these seven rust-susceptible varieties averaged only 2.6 bushels per acre, while the general average of the three resistant groups was 10.8 bushels. The separate group averages were as follows: rust-free, 11.0 bushels; rust-proof, 10.17 bushels; rust-enduring, 11.55 bushels. If a line is drawn across table I between Improved Goddard and Snowflake it will throw all of the resistant varieties above the line and all of the susceptible varieties, with the exception of Lady Washington, below it. Lady Washington, as stated previously, was not quite as susceptible as the other varieties in this group. Some ten percent of the plants were markedly resistant and the yield from these undoubtedly increased the yield of the

PLATE 4



TEPARY, a rust-susceptible variety. Defoliation from the rust is practically complete. Nothing remains but the vine skeleton.



BLUE POD NAVY, a rust-enduring variety. The plant is growing and blooming vigorously. Both photographed July 24.

row to an appreciable extent. Improved Goddard, on the other hand, is not a field type of bean and not a heavy bearer. It is, however, an excellent garden variety, especially suited for early green-shell use.

The yields of some of the varieties which were resistant to rust were modified to some extent by anthracnose and blight, but these diseases did not influence the yields of the rust-susceptible varieties since they came later in the season when the rust injury was practically completed. Yellow Eye and Mexican Red were most susceptible to blight and White Marrow, Improved Goddard, Dwarf Horticultural, and French's Horticultural to anthracnose. Well's Red Kidney¹ and Blue Pod Navy showed the least injury from anthracnose and blight.

Varieties Recommended for Dry-Shell Production

Of the commercial varieties grown in the eastern States, Red Kidney, Navy Pea, White Marrow and Yellow Eye are among the most popular. Navy Pea is more commonly planted in Virginia than any other variety, and the number of complaints of rust injury on field beans may be largely attributed to the choice of this susceptible variety. Many who grew dry beans for the first time in response to war needs selected the pea type.

Lady Washington, Pinto, Pink and Mexican Red are seemingly the most popular beans in the West. None of these is grown to any appreciable extent in Virginia, although Pink is occasionally seen on the market from local sources.

Dwarf Horticultural, under the name of Bush October, Speckled Cranberry, or Wren's Egg, is very popular in many parts of the State, although it is not so universally known as Navy Pea. It is grown commercially in south-western Virginia in some fields of ten or more acres. In addition to its rust resistance and productiveness, it is of excellent quality. The dry beans are large and attractive and are buff in color with spots and streaks of dark red. This variety can be recommended for home use and for commercial production where the market does not demand a white bean. Red Kidney would doubtless prove equal if not superior to Dwarf Horticultural from the standpoint of production. In quality Dwarf Horticultural is, in our opinion, slightly superior, but that is a matter of personal preference. Mexican Red deserves a trial. It is a plump bean of the marrow type with a solid red seed coat. Its earliness makes it especially suited for late planting or high altitudes where the season is short.

¹This variety is said to be very popular among the bean growers in New York on account of its resistance to anthracnose. Dr. M. F. Barrus, who first reported this resistance of Well's selection of the Red Kidney (see *Phytopathology* 5:303-311. 1915), kindly furnished the seed for our tests.

PLATE 5



A—Blight on a bean pod. B—Anthracnose on bean pods. C—Rust on a pod of Kentucky Wonder.

Where a preference exists for a white bean, White Marrow may be recommended. White Kidney, though resistant to rust, was low in yield. It is an attractive bean, however, and may prove equally good as White Marrow in some locations. Blue Pod Navy is unattractive. The seed coat is a dirty white color and it discolors easily. The four other white beans tested should be avoided on account of their susceptibility to rust. Yellow Eye, a white bean with a yellow band around the eye, is very similar to White Marrow except in color. It can be grown without danger of loss from rust.

In selecting a bean it is a good plan to test several varieties in order to determine the one best suited to local conditions.

Summary of Recommendations of Dry-Shell Varieties

USE: *Dwarf Horticultural* and *Red Kidney* for colored beans; *White Marrow* and *White Kidney* for white beans.

AVOID: *Navy Pea*, *Snowflake*, *Pinto*, *Pink*, *Tepary*.

TESTS OF GARDEN VARIETIES OF BEANS

1.—*Pole or climbing beans.*—Of the garden varieties of beans the pole beans as a rule suffer much greater losses from attacks of rust than do the bush or dwarf beans. This may be due in part to the shorter growing season of the bush beans which enables them to produce a crop before the rust becomes well established. Furthermore, some of the most popular varieties of pole beans are among the most susceptible to rust, and the practice of planting pole beans in the same part of the garden for several consecutive seasons should tend materially to increase the chances of early and heavy rust infection.

Nineteen varieties of pole beans were used in our test. They were planted on May 20, 1918, with a single row 22 feet long to each variety. All were inoculated with rust spores on June 4 and June 17.

The destructive action of the rust fungus and the contrast between the more susceptible and more resistant varieties was even more striking than that shown in the field of dry-shell beans (see plate 1 A). Within a month after the first inoculation the susceptible varieties were covered with rust pustules and defoliation was under way. By August 1, five varieties, Powell's Prolific, Creaseback (Fat Horse), Cut Short, Royal Corn and Virginia Cornfield were practically dead as a result of the rust attack. Most of the plants of these varieties had not grown more than one or two feet in height and none had produced a single mature pod. Kentucky Wonder, Burger's Stringless (White Kentucky Wonder), and Case Knife bore up under the rust attack longer than the preceding varieties, but were ultimately killed and produced only a few pods. Kentucky Wonder Wax and Golden Cluster, although conspicuously rusted, were not killed by the attack, but their yields were reduced to some extent.

Seven other varieties, Horticultural Pole, Tennessee Wonder, Brockton, Mont d'Or, Marblehead, Indian Chief, and Everbearing, were not injured by the rust. There was no leaf death and few or no pustules were produced.

Two other varieties, Yard Long and Lazy Wife, were planted in this test. Yard Long proved entirely rust-free. This variety, which is also called Asparagus Bean, is more of a garden curiosity than an esculent. It is not included in the table. A poor stand was obtained in the row of Lazy Wife, only ten plants developing. Four of these were heavily rusted and six were rust-proof. Previous tests in the greenhouse of several lots of seed of this variety showed the same variability. It should be possible to select a resistant strain of this desirable variety. It is omitted from the table on account of the poor stand.

The yields of the pole beans are given in table II in dry weight of seeds. A line drawn here, as in table I, between the susceptible and resistant

varieties separates them into two groups with the exception of Everbearing which falls below the line in yield. The yield of this variety was heavily curtailed by anthracnose. Marblehead, Indian Chief, Golden Cluster, Kentucky Wonder Wax, Mont d'Or, and Brockton were also, though less severely, attacked by anthracnose. This disease did not, however, contribute to the death of the rust-susceptible varieties.

TABLE II.—*Yield and Susceptibility to Rust of Pole Bean Varieties*

VARIETY	GRAMS DRY BEANS	SUSCEPTIBILITY TO RUST	KIND OF POD
Horticultural Pole.....	897	rust-proof	green
Tennessee Wonder.....	751	"	"
Brockton.....	556	rust-free	"
Mont d'Or.....	506	"	wax
Marblehead Pole.....	373	"	green
Golden Cluster.....	263	rust-enduring	wax
Indian Chief.....	261	rust-free	"
Kentucky Wonder Wax.....	216	rust-enduring	"
Case Knife.....	159	rust-susceptible	green
Everbearing.....	143	rust-free	wax
Kentucky Wonder.....	109	rust-susceptible	green
Burger's Stringless.....	59	"	"
Royal Corn.....	0	"	"
Creaseback.....	0	"	"
Virginia Cornfield.....	0	"	"
Cut Short.....	0	"	"
Powell's Prolific.....	0	"	"

Varieties of Pole Beans Recommended

Kentucky Wonder is more generally grown in Virginia than any other pole variety. Although not quite so susceptible as some of the other varieties of pole beans, it suffers heavy losses and its use is almost certain to be followed sooner or later by an attack of rust. It should not be used on account of this susceptibility to rust, or at most should be grown with a rust-resistant variety as a safeguard against complete failure.

Of the varieties resistant to rust, Horticultural Pole stands almost alone in quality and productivity. This variety is very popular in many parts of the State where it is known locally as October, Speckled Cranberry or Wren's Egg. Its pods, which are splashed with red at maturity, are most attractive and of excellent quality in the snap stage. It has no superior as a green-shell bean and the dry beans are good for winter use. Brockton is very similar to Horticultural Pole. It is slightly earlier and the pods and beans are larger. It is not so easily obtained from seedsmen.

Tennessee Wonder is not to be recommended on account of its poor quality. It ranked next to Horticultural Pole in yield, however, and was resistant to both rust and anthracnose.

Mont d'Or was the best of the wax-pod pole varieties tested. It is attractive, of good quality, and resistant to rust.

Lazy Wife was unfortunately not adequately represented in the test. Although it is variable in resistance to rust, it would probably not be subject to serious injury. In a field test of a few varieties in 1916 it was only slightly attacked. Since more than half of the plants are rust-proof, it seems probable that the susceptible strain could be eliminated by selection of seed from the resistant plants. It is a most desirable variety and the plump, white beans are excellent for green-shell or dry use.

Summary of Recommendations of Varieties of Pole Beans

USE: *Horticultural Pole, Brockton and Lazy Wife for green-pods; Mont d'Or for wax-pod.*

AVOID: *Kentucky Wonder, Burger's Stringless, Royal Corn, Creaseback, Virginia Cornfield, Cut Short, Powell's Prolific.*

2.—*Bush beans for snap use.*—Forty-two varieties of bush beans were grown, nineteen of which were green-pods and twenty-three wax-pods. Each variety occupied 16 feet of row space. Plantings of Tennessee Green Pod were made in four places in the field for purposes of comparison. On account of its extreme susceptibility to rust we have used this variety as a standard. The bush varieties were planted on the same day as the pole varieties and were inoculated with rust spores at the same time.

Aside from Tennessee Green Pod none of the bush varieties were severely injured by the rust attack. The leaves of this variety were so completely covered with pustules and leaf-fall was so rapid that the four rows could be picked out in the field at a distance within a month after the rust inoculation. Most of the plants were defoliated and dead by the middle of July and all were dead by the first of August. Eighty percent of the plants produced no pods and the remainder bore only two or three pods to the plant and those did not fill.

As a rule the heaviest rust infection of the other varieties was found on the green-pods. Those which showed the greatest number of rust pustules were Longfellow, Bountiful, Red Valentine, Full Measure, May Queen, Round Six Weeks, and Home Sweet Home. These varieties were perhaps injured to some extent by the rust, but not at all seriously and not enough to warrant their rejection on account of susceptibility to rust. Of the wax

varieties only two, Davis and Trucker's Reward, showed any appreciable amount of rust.

The most resistant green-pod varieties were Hodson Green Pod, Early Refugee, Low's Champion, Refugee, New Emerald Beauty, Black Valentine, Mighty Nice and Warren.

Burpee's Stringless, Giant Stringless and Full Measure were intermediate between the first and second groups. Burpee's Stringless produced a number of very small pustules, but it was markedly rust-enduring.

The yield of many of the wax-pod varieties and of some of the green-pods also was very heavily curtailed by anthracnose. The wax-pods most seriously affected were Hardy Wax, Detroit, Challenge Black Wax, Currie, California Rust Proof, Webber, Dwarf Black and Sure Crop. Mohawk, Full Measure, New Emerald Beauty and May Queen were the most susceptible of the green-pods to anthracnose.

The best green-pod varieties from the standpoint of resistance to rust and anthracnose, and productivity were Hodson Green Pod, Refugee, Low's Champion, Black Valentine, Burpee's Stringless and Warren; while the best of the wax-pods were Hodson Wax, New Pearl¹, Yellow Pencil Pod, Crystal Wax and Keeney's Rustless.

Since the yields of the varieties in this series were so greatly modified by anthracnose and, with the single exception of Tennessee Green Pod, to such a slight degree by the rust attack, they are not given here. A complete list of those tested grouped according to their susceptibility to rust is given below.

Green-pod Varieties

RUST-FREE: Low's Champion, Refugee.

RUST-PROOF: Black Valentine, Burpee's Stringless, Early Refugee, Giant Stringless, Hodson Green Pod, Mighty Nice, Mohawk, New Emerald Beauty, Warren.

RUST-ENDURING: Bountiful, Full Measure, Home Sweet Home, Longfellow, May Queen, Red Valentine, Round Six Weeks.

RUST-SUSCEPTIBLE: Tennessee Green Pod.

Wax-pod Varieties

RUST-FREE: Brittle Wax, Challenge Black Wax, Crystal Wax, Currie, Dwarf Black, Golden Eye, Hardy Wax, Hodson Wax, Keeney's Rustless,

¹This variety is very similar to Hodson Wax and is probably identical with it.

New Kidney, New Pearl, Pencil Pod Black, Round Pod Kidney, Scarlet Wax, Sure Crop, Wardwell, Yellow Pencil Pod.

RUST-PROOF: California Rust Proof, Detroit, Flagolet Wax, Webber.

RUST-ENDURING: Davis, Trucker's Reward.

Summary of Recommendations of Varieties of Bush Beans

AVOID: Tennessee Green Pod. This is the only variety of this group tested which proved so susceptible to rust that its planting cannot be recommended.

USE: From the standpoint of resistance to rust any of the varieties tested except Tennessee Green Pod. The varieties which proved best in our test were:

GREEN-PODS: Black Valentine, Burpee's Stringless, Hodson Green Pod, Low's Champion, Refugee and Warren.

WAX-PODS: Crystal Wax, Hodson Wax, Keeney's Rustless, New Pearl and Yellow Pencil Pod.

There are in addition a number of desirable varieties, some of which might well prove better suited to local conditions and individual tastes.

GENERAL RECOMMENDATIONS FOR THE CONTROL OF BEAN DISEASES

Use resistant varieties.—Losses from bean rust may be eliminated by the use of resistant varieties as outlined in this bulletin.

Select clean seed from clean pods.—Losses from anthracnose and blight may be reduced to a minimum by saving seed from pods which are entirely free from spots. The selection of clean pods should be made in the field and these clean pods should be harvested and threshed out separately.

Rotate and avoid disease-bearing material.—Rotation is important as a supplement to seed selection in the control of anthracnose and blight. If diseased vines are fed to animals the manure may be safely used, but the unfed straw should be avoided.

Do not work or pick beans while the tops are wet.—Anthracnose does not spread in the field easily except when the plants are wet. Do not pick, cultivate, or walk through the field unnecessarily when the plants are wet with dew or rain.

